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Learning Media Based on Computer Simulation for Effective Parabolic Motion Learning

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Abstract

This study intends to: (1) create a parabolic motion learning program using computer simulations; (2) explain the effectiveness of parabolic motion learning using computer simulations; and (3) define the degree of effectiveness of parabolic motility learning using personal computer simulations. A computer simulation-based parabolic motility simulation learning program, involving analysis, design, coding, and testing, is created as part of the study procedure. The efficiency of a learning program based on computer simulations to simulate parabolic motility is the second area of inquiry. employing the entire sampling method for sampling. This led the researcher to select a 40-person sample of all Master of Science students enrolled in semesters 1 and 3 of the 2021–2022 academic year. The N-Gain value of 0.65, which falls into the high or very effective category, indicates that the computer simulation-based parabolic motility simulation learning software is employed efficiently in learning, according to the study's findings. According to the questionnaire, the computer simulation-based 2-dimensional motility simulation is successfully applied to two-dimensional motility material, as evidenced by the score of 4.4 (on a scale of 1-5), which falls under the category of effectively applied.

Keywords: *Effective, Implementation, Learning, Simulation, Two-Dimensional Motion*

A. Introduction

21st century education emphasizes students to have problem solving skills problems, critical thinking, and collaborative skills. Technology plays an important role in improve student skills. Online learning (on a network) is a shape of e-gaining knowledge of that's the utility of the improvement of information and verbal exchange technology (ICT), this can offer challenges and opportunities for students to broaden revolutionary thoughts, critical thinking, and skills. higher order thinking. Various studies have supported e-learning programs as an educational tool, a number of literatures specializes in using e-learning at the elementary school to university level. The results of previous studies indicate that the pedagogical value of e-learning lies in the ability of the e-learning program itself, which is interactive multimedia, so that users have the option of being proactive as well as reactive or passive. By "active users," we mean those who are able to study physics on their own initiative rather than just responding to the computer's prompts [1]. Computers also allow individualization in learning physics, so that teaching and exercise materials can be arranged according to the user's developmental model.

Computers allow education management to be carried out using a database of student progress, so that the development of user abilities (students) can be recorded and can be used for good teaching and learning strategies. Using information technology to create an e-learning model typically differs from the actual conditions of teaching. Conditions may include, but are not limited to, equipment, teaching strategies, students, and qualified instructors for physical education. The low physics learning results of students demonstrate the truth that certain pupils are less motivated to learn physics and have trouble comprehending the subject matter. Understanding a certain concept is extremely important in physical education, and for that reason, animations that can reveal physical complexities must be emphasized without deviating from other processes. Due to this, the ideal e-learning system for science must be able to function as a medium for information delivery in the forms of text, graphics, simulations, animations, lectures, quantitative analyses, open-ended exercises, individual instruction that is in line with the learner's goals, and real-time feedback so that it can impart concepts that are useful.

E-learning programs put their users to work, through knowledge of identifying problems and arguing that e-learning programs are motivating technologies because they speak to fundamental human needs and are

both concrete and complex. E-learning programs may affect students' learning in a variety of subject areas (such as physics, mathematics, engineering, informatics, and others) as well as their personal development, which includes the acquisition of cognitive, metacognitive, and social skills. These include 21st century skills like research, creative thinking, decision making, problem solving, communication, and discovery.

21st century education integrates Science, Technology, Engineering, and Mathematics (STEM) based education. The STEM model combines science, technology, engineering, and math into one coherent educational approach based on practical applications. Currently, students are less interested in the STEM Model, one way to increase student interest through e-learning programs. E-learning programs have become a popular kind of education because they provide students with hands-on, enjoyable learning experiences in a classroom setting that can spark their interest and curiosity. Students are encouraged to obtain the skills and knowledge necessary to complete the topics they are interested in through a pleasant learning environment [2]. In the context of education, e-learning is described as an information technology application that takes the shape of virtual schools [3]. However, formally and informally conducted learning that utilizes electronic media, such as the Internet, Intranet, Extranet, CDROM, video tape, DVD, TV, mobile, PDA, etc., is generally referred to as e-learning [4].

Since intrinsic motivation comes from within the learner and is therefore psychologically relatively steady and pure, it should be cultivated to its full potential in order to maximize student learning efficacy. E-learning must be able to present/create a relevant, comprehensive, and efficient learning process in order to foster this drive. If Ngain is 0.7 [5], students are deemed to be exceptionally effective learners. Additionally, according to research, if used properly, Virtual Classroom can offer a number of other appealing alternatives [6]. People are very interested in virtual learning since it has the potential to improve the effectiveness of the learning process. [7].

Online courses typically succeed when they are founded on pedagogical understanding and have been prepared with care. Students can learn freely, comprehend abstract concepts more easily, and complete virtual practicums thanks to e-learning [8]. If physics lessons are presented with accurate and quality animation, pupils find them easier to consume [9]. Computer utilization can promote effective student administration, efficient learning management, and meaningful learning [10]. Additionally, studies on the use of games and 3D animation for learning in junior high schools with the subject of "Bangun Ruang" reveal a notable distinction between the learning outcomes of conventional learning and learning using games and 3D animation. More than 70% or above of students respond well to the usage of games and 3D animation in the classroom [11]. Multiple Representations Using ICT to Advance Physics Education Enhance conceptual grasp of kinematics, have good perception, and be highly motivated (Ishafit, 2014). Another study revealed that: Feedback Simulation Based Physics Learning Program Using a Press Center Stability Controller Walking Bipedal Robot to teach balance and center of mass is very successful [12]. E-learning plays a role in physics learning [13]. E-learning contributes as a platform for dual intelligence development [14].

Based on the literature, it is known that to change conventional learning to a meaningful learning system, it is necessary to create an interesting learning atmosphere with good substance so that the planting of the right concept can be carried out. The problem is, to make learning physics meaningful and instilling the right concepts is not as easy as one might think, because physics is a science that is partly empirical, mathematical, and also abstract, so an effort is needed to interpret it and be interested in it. Computers can help to make abstract concepts "concrete" in e-learning so that students can understand them more easily. The creation of a computer simulation-based Parabolic motion simulation program as a learning tool to improve Parabolic motion learning is the focus of this research.

B. Research Methods

Research in software engineering and research in education both fall under this category. The goal of direct experimental research in software engineering is to imitate two-dimensional motion. After software engineering research, education research was continued. Two-dimensional motion simulation is used as a medium and teaching material in two-dimensional motion learning. Software engineering research and educational research are carried out at Master of Science FKIP UNIB Bengkulu from May to September 2022.

Materials and Tools

A computer, a flat table, and learning software serve as the simulation's equipment.

Research Stage

The computer that has loaded the simulation program is then carried out various Parabolic motion maneuvers on the motion of the Parabolic, so that a large change in the angle, height and range of the bullet is seen on the monitor screen when there is a change in the angle and velocity of the Parabolic. Changing the input to different elevation angles demonstrates how the range and height of the bullet may be changed.

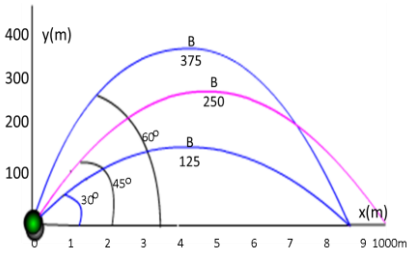

Figure 1. Motion of a Parabolic t with various angles of elevation on a flat plane

Characteristics of Parabolic Motion Simulation

Simulation is a training method that demonstrates something in an artificial form that is similar to the real situation [15]. The qualities, look, and attributes of a real system can be imitated or described by simulation [16]. Due to the difficulty of practicing in real scenarios, the simulation method involves transferring a genuine situation to a learning space [17].

The motion of the bullet is a combination of uniform straight motion on the x-axis with uniformly changing motion on the y-axis, it is said to be parabolic motion because the graph of y = f(x) is in the form of a curve. On the x-axis: Uniform Motion (GLB) applies:

$$v_x = v_{ox} = v_o \cos\beta, \quad x = v_{ox}.t = v_o \cos\beta.t \tag{1}$$

On the y-axis: Uniform Straight Motion applies:

$$v_y = v_{oy} - gt = v_o \sin\beta - gt,\ y = v_{oy}.t - \tfrac{1}{2} gt^2 = v_o \sin\beta.t - \tfrac{1}{2} gt^2 \tag{2}$$

The speed of an object at a point on its path can be calculated using the formula

$$v = \sqrt{(v_{ox}^2 + v_{ox}^2)} \tag{3}$$

While the direction of the vector is calculated using the equation

$$Tg\ \emptyset = \left(\frac{v_v}{v_x}\right) \tag{4}$$

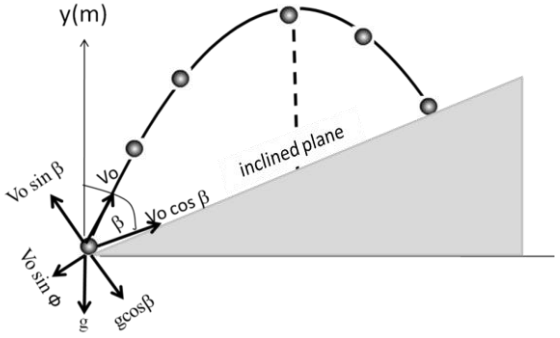

Figure 2. Motion of a Parabolic on an inclined plane

Implementation in education

Implementation in educational research uses parabolic motion simulation as a medium and teaching material in learning. The research design is presented in Table 1.

Table 1. Research Design

Pre-test	Treatment	Post-test
O_1	X	O_2

Information
X: Simulating parabolic motion to facilitate learning
Initial Assessment (pre-test)
O2: Post-final examination
40 S2 Science students from semesters 1 and 3 of the 2021–2022 academic year served as the study's subject population.

Data collection

Question: The purpose of the test is to evaluate how well the computer simulation-based physics learning program works. The test questions are modified to reflect the targeted learning competencies. 30 questions were used in this investigation.

Questionnaire: Each research sample or subject is asked to respond to a questionnaire asking about the goal and function of the computer simulation-based physics learning program in promoting efficient student learning. All samples were given copies of the computer simulation-based parabolic motion learning program to study. The questionnaire consists of 40 statements, each with five possible answers subject to the following limitations:

Table 2. Choice criteria and scores on the questionnaire

No	option	Score	category
1	Strongly agree	5	A
2	Agree	4	B
3	Just agree	3	C
4	Do not agree	2	D
5	Strongly disagree	1	E

Processing data

The results of the pretest and posttest are combined with the algorithm to get the student learning outcomes data.

$$N_{gain} = \frac{x_3 - x_1}{x_3 - x_1} \quad (5)$$

Pretest score is x1, posttest score is x2, and highest score is x3.
using survey data to assess the following factors, the efficiency of learning

Table 3. Evaluation standards for computer simulation-based physics education

No	Skor	Category	Quality
1	5	A	Very good
2	4	B	Good
3	3	C	Currently
4	2	D	Not enough
5	1	E	Bad

Data analysis

Manual calculations were employed to test the efficacy of the Computer Simulation-Based Physics Learning Program, namely the N-Gain effectiveness formula. N-Gain is equal to the initial ability test score minus the posttest score. initial aptitude: highest score testing outcomes for 18 and 19. Normalized Gain (N-Gain) Pretest = Initial Learning Value Post-test = Overall learning value. If the students' post-test scores are higher than their pre-test scores (X2 > X1) and there are more students who receive scores of 70 to 80 percent, the computer simulation-based physics learning program is regarded to be successful in helping the students understand physics. The Ngain formula, which compares the difference between the pretest and posttest with the difference between the maximum value and the pretest, is used to calculate the efficacy of studying physics. It is formulated as follows

$$N_{gain} = \frac{x_3 - x_1}{x_3 - x_1} \text{ [20]}$$

The magnitudes of X1, X2, X3 are each as a pre-test value, post-test value and maximum value, The Ngain number, which ranges from 0 to 1, is used to gauge how effective using physics learning software built

using macromedia simulations is, the following criteria are used.

Table 4. Index Gain criteria

No	Effectiveness Level	N_{gain}	Category
1	Very effective	≥ 0,70	Tall
2	Effective	0,30-0,70	Currently
3	Effective enough	0,30	Low

A questionnaire with the following criteria is also used to assess the efficiency of a computer simulation-based physics learning program.

Table 5. Evaluation standards for computer simulation-based physics education

No	Criteria	Quality	Category
1	4,50 – 5,00	A	Very effective
2	3,51 – 4,50	B	Effective
3	2,51 – 3,50	C	Less effective
4	1,51 – 2,50	D	Ineffective
5	< 1,5	E	Very ineffective

The scores obtained are then processed with SPSS

C. Results and Discussion

1. Parabolic motion simulation

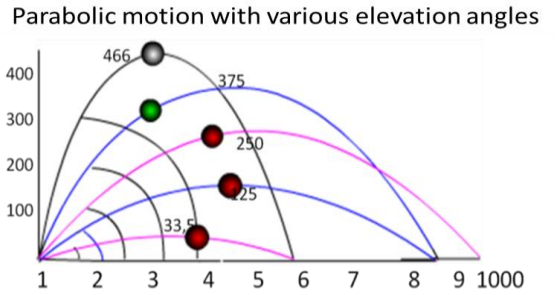

Figure 3. Simulation of Parabolic Motion at Elevation Angle 15º, 30º, 45º, 60º, dan 75º

2. Implementation in Education

Implementation In 2022, this study was conducted at S2 IPA FKIP UNIB Bengkulu. The purpose of this study is to evaluate the efficacy of macromedia-based simulations as teaching tools for parabolic motion. Both a pretest and a posttest were administered to evaluate the effectiveness of the learning. Before learning is put into practice, the pretest tries to ascertain the students' initial comprehension of the parabolic motion subject. The purpose of the posttest is to assess students' comprehension of the parabolic motion topic following instruction utilizing a macromedia-based parabolic motion simulation. There are 30 multiple-choice questions, and while the questions on the pretest and posttest are identical, the posttest's questions have been changed slightly from those on the pretest. Figure 4 and Table 6 show the outcomes of the pretest and posttest, respectively.

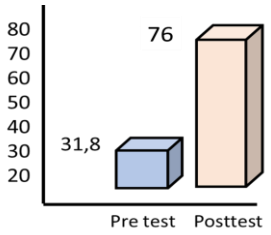

Figure 4. Graph of pretest and posttest

According to calculations made with SPSS, the post-test learning outcomes' standard deviation is 8.54, while the questionnaire's standard deviation is 0.212. The average score of the questionnaire/learning

effectiveness was 4.4; the study's findings demonstrate the Macromedia Simulation Learning Program's efficacy in teaching parabolic motion. An interactive multimedia system leads to effective learning utilizing the Computer Simulation Learning Program in parabolic motion learning because it involves nearly all of the five senses in knowledge acquisition. When using the computer simulation learning program for parabolic motion learning, students may learn at their own pace, from any location, and the simulations and animations are designed to keep them interested.

The Physics Learning Program Based on Feedback Simulation Press Center Stability Controller Walking Bipedal Robot's convenience and ease of use make it easy for students to feel at home while learning, which increases their excitement for the subject. In addition, the simulation learning program's display in parabolic motion learning enables all varieties of student intelligence to be accommodated and to grow and develop to their full potential. Nearly all student intelligence can be accommodated and manifested by e-learning learning programs built on the Computer Simulation Learning Program in parabolic motion learning. However, because there is no set definition of what constitutes a person's type of intelligence, the form that exists in e-learning learning programs based on the Computer Simulation Learning Program in parabolic motion learning has not been explicitly designated on certain types of intelligence. A person may possess various forms of intelligence, but only certain of these forms will stand out in that individual; also, the forms of intelligence that stand out vary from person to person. In general, the macromedia simulation learning software for parabolic motion learning can be described as being extremely straightforward, rapid, effective, affordable, and customizable.

Table 6. Recapitulation of pretest, posttest, and questionnaire scores

No	NPM	$(x_i - x)^2$	Pre test	Post test	Questionnaire
1	A2L021001	16	30	80	4.6
2	A2L021002	49	37	83	4.3
3	A2L021003	16	40	80	4.5
4	A2L021004	16	37	80	4.6
5	A2L021005	49	47	83	4.4
6	A2L021006	169	27	63	4.4
7	A2L021007	49	30	83	4.6
8	A2L021008	49	40	83	4.6
9	A1L021009	16	27	80	4.7
10	A2L021010	121	30	87	4.5
11	A2L021011	1	30	77	4.2
12	A2L021012	16	27	80	4.4
13	A2L021013	16	33	80	4.6
14	A2L021014	36	13	70	3.9
15	A2L021015	169	27	63	4.5
16	A2L021016	9	27	73	4.2
17	A2L021017	81	27	67	4.3
18	A2L021018	36	37	70	4.6
19	A2L021019	49	50	83	4.3
20	A2L021020	529	20	53	4.5
21	A2L020001	121	40	87	4.2
22	A2L020002	1	27	77	4.4
23	A2L020003	16	30	80	4.4
24	A2L020004	16	30	80	4.6
25	A2L020005	36	27	70	4.6
26	A2L020006	169	33	63	4.6
27	A2L020007	9	13	73	4.5
28	A2L020008	225	27	61	4.2
29	A2L020009	36	27	70	4.4
30	A2L020010	49	27	83	4.6
31	A2L020011	169	37	63	4.4
32	A2L020012	16	50	80	4.5
33	A2L020013	49	20	83	3.8
34	A2L020014	16	30	80	3.8
35	A2L020015	16	37	80	4.6
36	A2L020016	49	40	83	4.3

No	NPM	$(x_i - x)^2$	Pre test	Post test	Questionnaire
37	A2L020017	169	37	63	4.5
38	A2L020018	49	47	83	4.4
39	A2L020019	49	27	83	4.4
40	A2L020020	16	30	80	4.4
	Total	2768	1272	3040	176.3
	Average		31.8	76	4.4075
	Standard Dev.		8.54	8.42	0.212

Pretest = number of correct answers pretest, scale 100
Posttest = number of correct answers posttest, scale 100
Based on table 6 the magnitude of N_{Gain} can be calculated using the formula

$$N_{Gain} = \frac{(76 - 31.8)}{(100 - 31.8)} = \frac{(44.2)}{(68.2)} = 0{,}65$$

whereas the formula is used to get the standard deviation

$$S = \sqrt{\frac{\sum_{i=1}^{n}(x_i + x)^2}{n - 1}}$$

The Macromedia Simulation Learning Program's display for parabolic motion learning includes training modules as well as animations, simulations, visualizations, demos, and analysis modules that help students' misconceptions about physics diminish. This is a result of efforts to make concrete what students previously thought to be abstract. This finding is consistent with other findings that show how e-learning is used in education across the globe.

According to research conducted in Europe, remote and open learning models that incorporate Howard Gardner's multiple intelligences not only serve as a vehicle for the dissemination of knowledge but also a way of achieving higher levels of comprehension and awareness, as well as reflecting the function of education [21]. According to South African research, learning should be built on different intelligences in order to maximize kids' potential [22]. When used and supported by e-Learning tools, all types of intelligence can grow and develop properly during the learning process [23]. The aforementioned findings are in line with earlier findings from a survey answered by 45 people, which demonstrated that the Product-Service System (PSS) model was successfully applied to identify the Virtual Classroom development roadmap as a whole. Furthermore, studies on the use of Interactive 3D E-Learning in SMP No. 151 and MTs No. 77B/95 Bandung show that it is preferred and highly preferred (S+SS) to be used as a learning medium 74%, improving cognitive abilities 83%, interesting and user-friendly 77%, and inspiring and attracting interest in learning 78%. DB Sianipar since 2010 [25]. It is now defined by the availability of an online learning format known as e-learning, in addition to the aforementioned research findings [26]. In web-based real analysis courses, student interest and learning achievement increased, and 92.5% of students' learning objectives were met [27].

Planning (77.57%), content development (75.14%), content dissemination (66.14%), interaction (75%), evaluation (69.01%), and media learning (77.27%) were evaluated as having the highest levels of efficacy for e-learning. [28]. The majority of JPTE PT UNM students (75%) are enthusiastic in learning Electrical Installation 2 using animation created in Adobe Flash CS3 [29]. Biology instruction employing e-learning based on multiple intelligences and the human movement system demonstrates a 21% increase in learning outcomes and a 100% completion rate of the learning process [30]. Modules with teacher content, which includes announcements, questions, the uploading of instructional materials, the checking and announcing of exam results, as well as content, serve as examples of e-learning as an interactive learning medium based on information technology. Students can read announcements, exam results, and lesson plans [31]. At SMA N 10 Bandar Lampung, an e-learning system is being used to enhance teaching and learning. Using the findings of the study, a Learning Management System for online instruction was created [32].

The creation of E-learning-Based Online Learning Methods in the Computer Engineering Programming Course at IPB Bogor demonstrates that with the assistance of network facilities and infrastructure, disseminating these methods to the academic community at the Directorate of Diploma Programs of IPB can be accomplished successfully [33]. Intelligent e-learning with personalization can be achieved using data mining techniques and decision support systems on elearning-ujb.net by recommending instructional materials, books, lecture materials, and journals that are in line with site visitors' interests [34]. According to the expert's assessment of the viability of e-learning, moodle is in the good category with a score of 3.98;

the media expert also agrees; the beta test places it in the very good category with a score of 4.15; and the product test places it in the good category with a score of 3.90, effectively enhancing student learning outcomes by 13.24 [35]. The experts' scores of 91.67% for the material component and 96.75% for the media element support the validity of e-learning supported by virtual laboratories. For online practicums, student survey results are 81.30%, and virtual laboratories are very practical to use [36].

In SMA N Gondang Rejo, blended learning with numbered heads together (NHT) was used to increase student interest and learning achievement in the subject of material solubility and solubility product. According to this study, student interest increased from 73.37% to 78.93%, mastery learning increased from 50.00% to 79.17%, and psychomotor achievement achieved 79.17% [37]. This result is largely consistent with earlier results that demonstrate how e-learning tools can encourage pupils to learn (Mayub, A, 2015). [38] The use of e-learning programs in the classroom can be beneficial [39] The use of e-learning programs in the classroom can considerably reduce students' misconceptions [40].

D. Conclusion

The N_{Gain} value of 0.67, which is in the medium or effective group, indicates that the Computer Simulation Learning Program in learning parabolic motion material is used effectively. It is clear from the score of 4.4 (on a scale of 1-5), which is in the effective category, that the Macromedia Simulation Learning Program questionnaire in learning parabolic motion is effectively employed for equilibrium and center of mass content.

E. Acknowledgement

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References

[1] Sutrisno. (1993). *Fisika Komputasi dan Kurikulum Inti Pendidikan Sarjana Fisika dan Sarjana Pendidikan Fisika*, Jurusan Fisika ITB, Bandung.

[2] Eguchi, A. (2014). Educational Robotics for Promoting 21st Century Skills. *Journal of Automation Mobile Robotics and Intelligent Systems*, 8, 5-11. https://doi.org/10.14313/ JAMRIS_1-2014/1

[3] Purbo O.W., Hartanto, A.A., (2001)*Teknologi e-Learning"*, PT Elex Media Komputindo, Jakarta.

[4] Team E-learning., (2004).*Buku Panduan WebCT 4.1 Untuk Pengajar",* Universiteit Utrecht dan Universitas Padjadjaran, Bandung.

[5] Sugiyono. (2017). *Metode Penelitian Kuantitatif, Kualitatifdan R & D. Bandung",* Alfabeta. CV.

[6] Marie, Georgianna., (2009). *Virtual Classroom Instruction: Strategies for Keeping Participants Engaged*", Diakses Februari 2010 dari http://www. gmariegroup.com/VILTWorkshop/ ASTD_TK_20.

[7] Haryono, A., & Alatas, A., (2012). Virtual Learning/Virtual Classroom, Sebagai model pendidikan jarak jauh: Konsep dan penerapannya, *Seminar Nasional Teknologi Pembelajaran,* Balai Besar Pengembangan Teknologi Tepat Guna-LIPI, 2012.

[8] Mustadji., (2012).*Pemanfaatan Multimedia Untuk Meningkatkan kualitas Pendidikan*, seminar AKAL interaktif di TB., Gramedia EXSPO Surabaya, 2011,

[9] DePorter and Hernacki. (2011). *Differences in Learning Method Using Quantum Learning Flash Animation with Conventional Learning On The Concept of Temperature and Heat, Google Translate for Business*: Translator Toolkit Website Translator Global Market Finder,

[10] Morten Brekke, Peter Henrik Hosstad., (2010). New Teaching Method-Using computer technology in physics, mathematics and compoter science", *International Journal of digital Society*, Volume 1, issue 1, March, p.19

[11] Yandri., (2009). Desain, Implementasi dan Pengujian Efektivitas Interactive E-Learning Menggunakan Game dan Animasi 3D, *Sekolah Teknik Elektro dan Informtika*, ITB, Bandung.

[12] Mayub, A., Fahmizal., (2021)Learning Effectiveness of Equilibrium Concept of Objects Through the Walking Stability Bipedal Robots", *International Conference on Educational Sciences and Teacher Profession* (ICETeP 2020)

[13] Mayub, A., Fahmizal. (2020)Analysis of E-learning Program's Role in Physical Learning", *Journal of Advances in Information Systems and Technology*,

[14] A Mayub, F Fahmizal (2023). Developing Multiple Intelligences Through Ict-Based E-Learning Program, IJIET (International Journal of Indonesian Education and Teaching) 7 (1), 48-60

[15] Depdiknas., (2005). *Pembinaan Profesionalisme Tenaga pengajar (Pengembangan Profesionalisme Guru)*", Direktorat Jenderal Pendidikan dasar dan Menengah Direktorat Pendidikan Lanjutan Pertama Depdiknas, Jakarta,..

[16] Mayub A., (2018). ModelVirtual Classroom Fisika Sebagai wadah Pengembangan Inteligensi Ganda", ISBN. 78-602-8043-96-0 *Penerbit UPPFKIP UNIB*

[17] Othman, Ahmad Nizam bin., (2009). *Film Animasi Malaysia: Narasi Verbal ke Visual", ITB J. Vis. Art & Des*., Vol. 3, No. 1, 2009, 79-88 79, 2009,

[18] Sugiyono., (2018). *Metode Penelitian Kombinasi (Mix Methods)*", Bandung: Alfabeta. CV. 2018.

[19] Sundaya, Rostina., (2014). *Stastistika Penelitian Pendidikan"*, Bandung: Alfabeta, 2014.

[20] Sugiyono., (2019). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*", Bandung: Alfabeta, 2019).

[21] Arkorful, V., & Abaidoo, N., (2014). The role of e-learning, advantages and disadvantages of its adoption in higher education*", International Journal of Instructional Technology and Distance Learning*, 12(1), 29-42, 2014.

[22] FE Gouws., (2008). Teachingand learning through multiple intelligences in the outcomes-based education classroom", *Journal Africa Education Review*, Volume 4, 2008.

[23] Kunjal Bharatkumar Mankad., (2015). The Role of Multiple Intelligence in E-Learning", IJSRD - *International Journal for Scientific Research & Development*, 3(05), 2015.

[24] Risnandar., (2010). *Perancangan e-learning dengan Pendekatan Product-Service System (PSS) dan DICE Framework*, Konferensi dan Temu Nasional Teknologi Informasi dan Komunikasi untuk Indonesia, Bandung. 2010.

[25] Sianipar DB., (2012). *Desain dan Pengembangan Interactive 3 Dalam Meningkatkan Kemampuan Kognitif Siswa*, Laporan Penelitian, Magister Teknik Elektro ITB, Bandung, 2010.

[26] Sehat Sempurna. (2012). Perkembanagn e-learning, Jur.Teknik Komputer dan jaringan, *ITB-SEOMOLEC*, Bandung, 2012.

[27] Dian Kurniati, Dinawati Trapsilasiwi., (2014). Pengembangan model Pembelajaran analisis real berbasis web dalam bentuk e-learning; © *Kadikma*, Vol.5, No.3, hal 1-12, Desember 2014

[28] Somayeh, M., Dehghani, M., Mozaffari, F., Ghasemnegad, S. M., Hakimi, H., & Samaneh, B., (2016). The effectiveness of E-learning in learning: A review of the literature", *International Journal Of edical Research & Health Sciences*, *5*(2), 86-91, 2016.

[29] Hasrul., (2011). Desain Media Pembelajaran Animasi berbasis Adobe Flash CS3 pada mata kuliah intalasi listrik 2, *Jurnal Medtek* , Vol.3 No.2 Oktober

[30] Isni Murdiyani., (2012). Pembelajaran Biologi menggunakan elearning berbasis multiple intelligences pada system gerak manusia", *Journal of Curriculum and Educational*, Vo.1, No.1, 2012, ISSN 2252-7125. 2012

[31] M. Yazdi., (2012). Elearning sebagai media pembelajaran interaktif berbasis Teknologi Informasi", *Jurnal Ilmiah Foristek* Vol.2, No.1, Maret 2012.

[32] Novi Hidayati., (2010). Sistem e-learning untuk meningkatkan proses belajar-mengajar pada SMA N 10 Bandar Lampung", *Jurnal Telematika Mkom* Vol.2, No.2, 2010

[33] Budi, Brian Nurjayanti., (2012). Pengembangan Metode Pembelajaran Online Berbasis E-learning pada mata kuliah Pemrograman Teknik Komputer IPB Bogor", *Jurnal Sains Terapan* Edisi II Vol.2 No.1 Hal 103-113, 2012.

[34] Agus S. A, (2010). E-learning cerdas dengan personalisasi menggunakan teknik data mining dan decision support system pada *elearning-ujb.net* Univ.Janabadra,Ykt", *Seminar Nasional Informatika*, Yogyakarta 2010; ISSN 1979-2328

[35] Zyainuri, Eko Marpanaji., (2012). Penerapan elearning moodle untuk pembelajaran siswa yang melaksanakan Prakerin", *Jurnal Pendidikan Vokasi*, Vol.2 No.3, 2012.

[36] Agustine, D., Wiyono, K., & Muslim, M., (2014). Pengembangan e-learning berbantuan virtual laboratory untuk mata kuliah praktikum Fisika Dasar II di Program Studi Pendidikan Fisika FKIP UNSRI", *Jurnal Inovasi dan Pembelajaran Fisika*, 1(1), 33-42, 2014.

[37] Jatmiko BP, J.S Sukarjo, Sri Mulyani; (2013). Penerapan Blended Learning dengan Numbered Heads Together (NHT) untuk meningkatkan minat dan prestasi belajar pada materi kelarutan dan hasil kali kelarutan di SMA N Gondangrejo", *Jurnal Pendidikan Kimia* Vol.2 No.4 Thn 2013, ISSN 2337-9995

[38] Mayub, A., (2015). *Implementasi Virtual Classroom Sebagai Upaya Memotivasi Mahasiswa Belajar Fisika,* Laporan Penelitian, Hibah Penelitian Pascasarjana IPA FKIP UNIB, 2015.

[39] Mayub, A., (2016). Analisis Peran e-learning dalam pembelajaran Fisika", *Prosiding SEMIRATA*

MIPA Wilayah Barat,UNSRI, Palembang 2016

[40] Mayub, A., (2017). Improvements of student Misconceptions of physics using the E-learning, *Proceeding Bengkulu International Confrence on Science and Education (BISCE-2017*), 2017.